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CLEAN AIR ACT 1956

MEMORANDUM ON CHIMNEY HEIGHTS

I. INTRODUCTORY

Scope of the memorandum

1. This memorandum is intended to provide, for the use of local authorities and others who may need to determine the height appropriate for certain new chimneys, a relatively simple method of calculating the approximate height commonly desirable in normal circumstances.

2. This method is to be regarded as a guide rather than a mathematically precise way of reaching a final decision on chimney height. It should be modified as seems necessary in the light of particular local circumstances. For example, a chimney in a narrow valley or near tall buildings may need to be higher than would otherwise be necessary.

3. The memorandum is not applicable to all chimneys. It is applicable only to (*a*) chimneys of industrial boiler plant of maximum continuous rating greater than approximately 650 lb. steam/hr. (or 0·65 million B.t.u./hr.) and not exceeding 450,000 lb. steam/hr. (or 450 million B.t.u./hr.) or to (*b*) chimneys serving furnaces burning fuel at a maximum rate greater than approximately 100 lb./hr. of coal or 50 lb./hr. of oil and not exceeding 50,000 lb./hr. of coal or 30,000 lb./hr. of oil.

4. The method of calculation is based on the amount of flue gases which the chimney is expected to emit as a function of the maximum rate of emission of sulphur dioxide. Modification of the result obtained may be necessary where there is a danger of pollution by gaseous effluents other than normal products of combustion.

5. Prejudice to health or nuisance from smoke, grit and dust should not occur where chimney heights are so calculated and where appropriate use is made of the other relevant provisions of the Clean Air Act. It should be noted that difficulty with grit and dust cannot be avoided solely by increasing the height of a chimney. Dust arrestment plant is also necessary.

Amount of sulphur dioxide emissions

6. For the purposes of the memorandum the amount of sulphur dioxide likely to be emitted may be calculated as follows. If the maximum rate at which coal or other solid fuel is burnt is W thousand lb./hr. and the sulphur content of the fuel is S per cent, the weight of sulphur dioxide emitted in the flue gas should be taken as 18 WS lb./hr. since about 10 per cent of the sulphur is retained in the ash. The average sulphur content of British coal is 1·6 per cent. As an example, a plant burning coal of sulphur content 1·6 per cent at a maximum rate of 9,000 lb./hr, emits 259 lb./hr. of sulphur dioxide. If the maximum rate at which oil is burnt is W thousand lb./hr. and its sulphur content is S per cent, the weight of sulphur dioxide emitted in the flue gas should be taken as 20 WS lb./hr. The average sulphur content of residual fuel oil used in boiler plant is about 3 per cent. One ton of oil may be taken to contain 235 gallons. Where the actual percentage of sulphur contained in the fuel is known, this figure should be used in the equations.

Efflux velocity

7. The diameter of a chimney top should be as small as possible in order to increase the efflux velocity of the flue gases. If the efflux velocity is insufficient, the plume of gas tends to flow down the outside of the stack on the lee side and the effective chimney height is thus reduced. Efflux velocities of about 50 ft./sec. will avoid this downwash.

8. Such a velocity is impracticable for small boilers, but boilers equipped with forced draught fans only should have a chimney efflux velocity of not less than 20 ft./sec. at full load. Boilers equipped with induced draught fans should have a chimney efflux velocity of not less than 25 ft./sec. at full load for boilers rated up to 30,000 lb./hr. increasing to a maximum of 50 ft./sec. at full load for boilers rated at 450,000 lb./hr.

9. The method of calculation assumes that the appropriate efflux velocity will be achieved.

Combining of Emissions

10. Where there are several adjacent furnaces in the same works, there are advantages in combining the waste gases if possible, and discharging them through a common chimney. The larger volume from the combined emissions has a higher thermal rise than the discharges from separate chimneys and the concentration of flue gases reaching the ground is smaller.

II. METHOD OF CALCULATING CHIMNEY HEIGHTS

"*Uncorrected chimney height*" *and* "*final chimney height*"

11. The first stage is the calculation of the "uncorrected chimney height". This is the height appropriate for the relevant maximum rate of sulphur dioxide emission when account has been taken of neighbouring sources of pollution, the local background level of pollution and the general character of the district. The uncorrected chimney height is never less than 40 feet.

12. The second stage is the calculation of the "final chimney height". This is the uncorrected chimney height amended if necessary to allow for the dispersal from the chimney being affected by the building to which the chimney is attached and by neighbouring buildings.

Calculation of uncorrected chimney height

13. The next step is to consider the character of the surrounding district which for this purpose should be regarded as falling within one of the following categories:

A an undeveloped area where development is unlikely, where background pollution is low, and where there is no development within half a mile of the new chimney.

B a partially developed area with scattered houses, low background pollution, and no other comparable industrial emissions within a quarter of a mile of the new chimney.

C a built-up residential area with only moderate background pollution and without other comparable industrial emissions.

D an urban area of mixed industrial and residential development, with considerable background pollution and with other comparable industrial emissions within a quarter of a mile of the new chimney.

E a large city, or an urban area of mixed heavy industrial and dense residential development, with severe background pollution.

14. When it has been decided into which of these categories the surrounding district falls, reference is then made to the relevant chart in Appendices I-IV, which relate respectively to very small installations, to small installations, to medium installations and to large installations. A line starting from the relevant sulphur dioxide emission on the left-hand side of the appropriate chart and produced through the points A, B, C, D or E (representing the category into which the district falls) will indicate on the right-hand side of the chart the appropriate uncorrected chimney height. In the case of an oil-fired plant designed to use oil containing more than 2 per cent sulphur, 10 per cent should be added to the uncorrected chimney height so indicated in order to allow for the average reduction in thermal lift compared with that of a similar emission of sulphur dioxide from coal-firing.

Example

A new chimney is needed for a plant burning coal and emitting 280 lb. sulphur dioxide per hour. What is the uncorrected chimney height in a district in category C and a district in category E? Reference to Appendix III will show that the respective uncorrected chimney heights are 107 feet and 126 feet.

Calculation of final chimney height

15. An uncorrected chimney height not less than 2½ times the height of the building to which the chimney is attached or of any other building in the immediate vicinity does not need to be corrected to allow for the effect of the building. In that case the final chimney height is the same as the uncorrected chimney height, and no further calculation is necessary.

16. Corrections for the effects of buildings are, however, necessary when the uncorrected chimney height is less than 2½ times the height of such buildings and these establish the final chimney height.

17. The correction is partly based on the ratio between the greatest length and height of the building (to the ridge), since the relationship between the greatest length and height influences the effect of down-draughts.

18. In a closely built-up area where the plant building is lower than adjacent buildings the chimney should for this purpose be regarded as being attached to an infinitely long building whose height is the average level of the roof tops in the immediate vicinity.

19. Reference is then made to the chart in Appendix V. A line starting from the relevant uncorrected chimney height on the left-hand side is produced through the point representing the building height to the reference line. From this point on the reference line another line produced through a point representing the height of the building or its greatest length, whichever is the lower, will indicate on the right-hand side of the chart the final chimney height, subject to any adjustment that may be necessary to ensure that this is never less than 10 feet above the ridge of the building, nor less than the uncorrected chimney height.

> *Example* 1
>
> A chimney whose uncorrected height is 120 ft. is attached to a building 100 ft. in height to the ridge of the roof; what will the final chimney height have to be if the maximum width of the building is (*a*) 100 ft. or more, (*b*) 50 ft. and (*c*) 20 ft.? Reference to Appendix V will show the three cases represented by dotted lines and the corresponding final heights are 169 ft., 140 ft. and 124 ft.
>
> *Example* 2
>
> A chimney whose uncorrected height is 60 ft. is attached to a building 80 ft. in height to the ridge of the roof; what should the final chimney height be if the maximum width of the building is (*a*) more than 80 ft., (*b*) 30 ft.? Reference to Appendix V will show the corresponding final heights to be 111 ft. and 84 ft. The final heights are therefore 111 ft. and 90 ft. respectively, since they must be at least 10 ft. above the ridge of the roof.

Suggestions for further reading

20. (*a*) O. G. Sutton, " Micrometeorology " (McGraw Hill Publishing Co. Ltd., London, 1953) and the "Theoretical Distribution of Airborne Pollution from Factory Chimneys", Quart. J. R. Met. Soc. 1947, Vol. 73, p. 426.

(*b*) C. H. Bosanquet, " The Rise of a Hot Smoke Plume ", J. Inst. Fuel, Vol. 30, p. 322 (1957).

(*c*) J. W. Hawkins and G. Nonhebel, " Chimneys and the Dispersal of Smoke ", J. Inst. Fuel, Vol. 28, p. 53 (1955).

(*d*) G. Nonhebel, " Recommendations on Heights for New Industrial Chimneys ", J. Inst. Fuel, Vol. 33, p. 479, October, 1960.

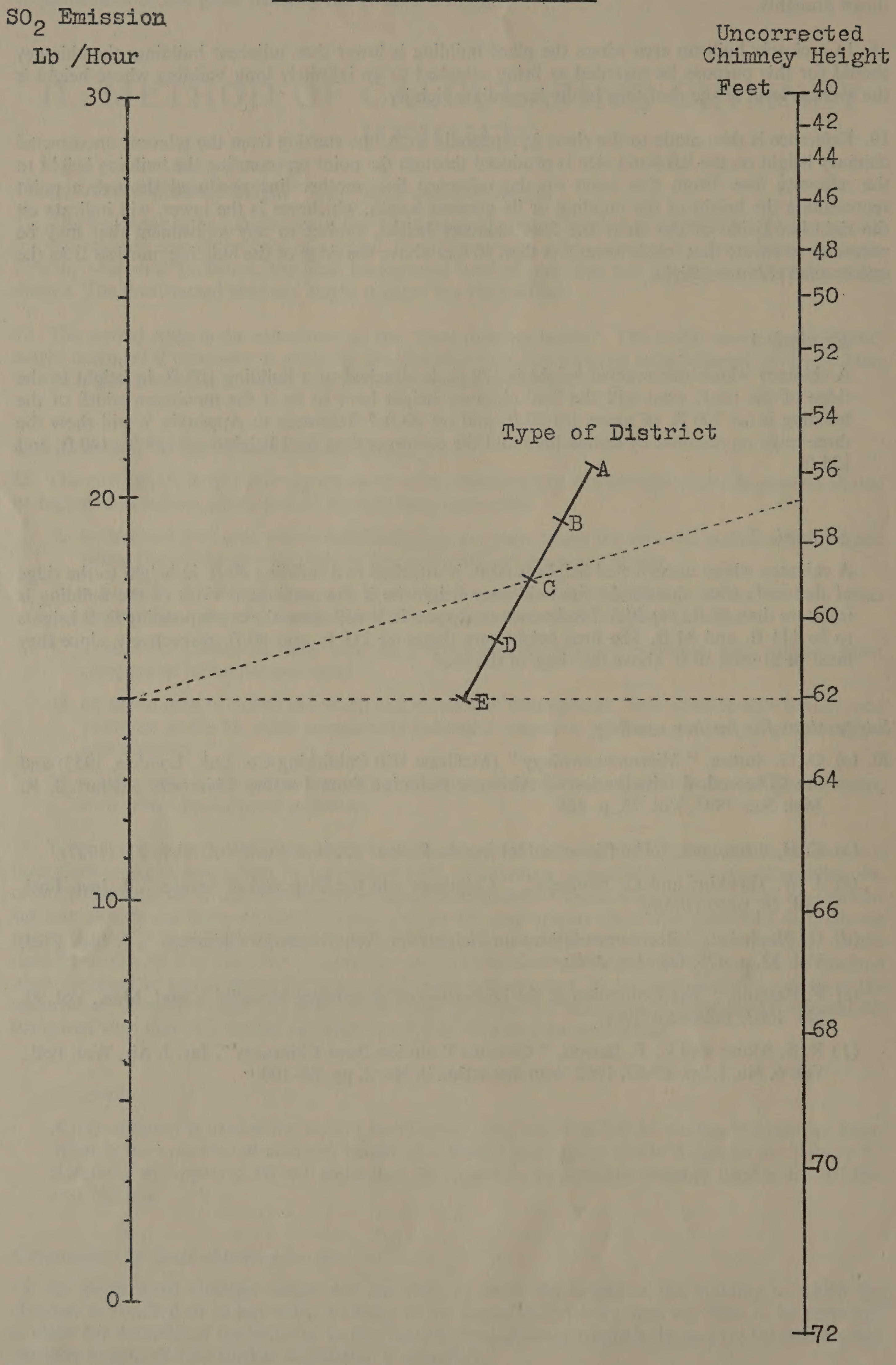
(*e*) F. Pasquill, " The Estimation of the Dispersion of Windborne Material ", Met. Mag., Vol. 90, No. 1063, February, 1961.

(*f*) R. S. Scorer and C. F. Barrett, " Gaseous Pollution from Chimneys ", Int. J. Air, Wat. Poll., Vol. 6, No. 1, pp. 49–63, 1962, with discussion in No. 2, pp. 85–100.

APPENDIX I

Uncorrected Chimney Heights

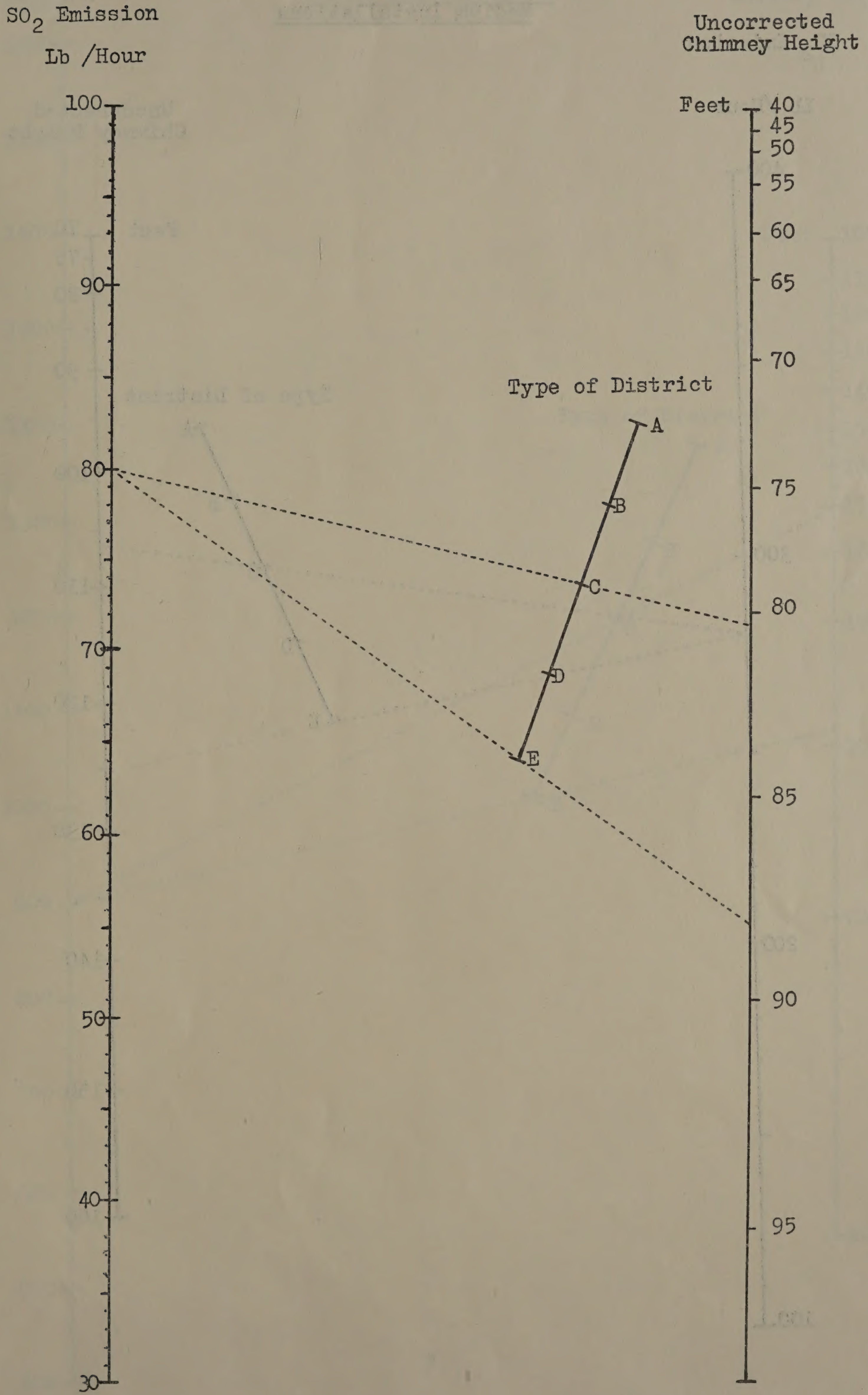
Very Small Installations



APPENDIX II

Uncorrected Chimney Heights

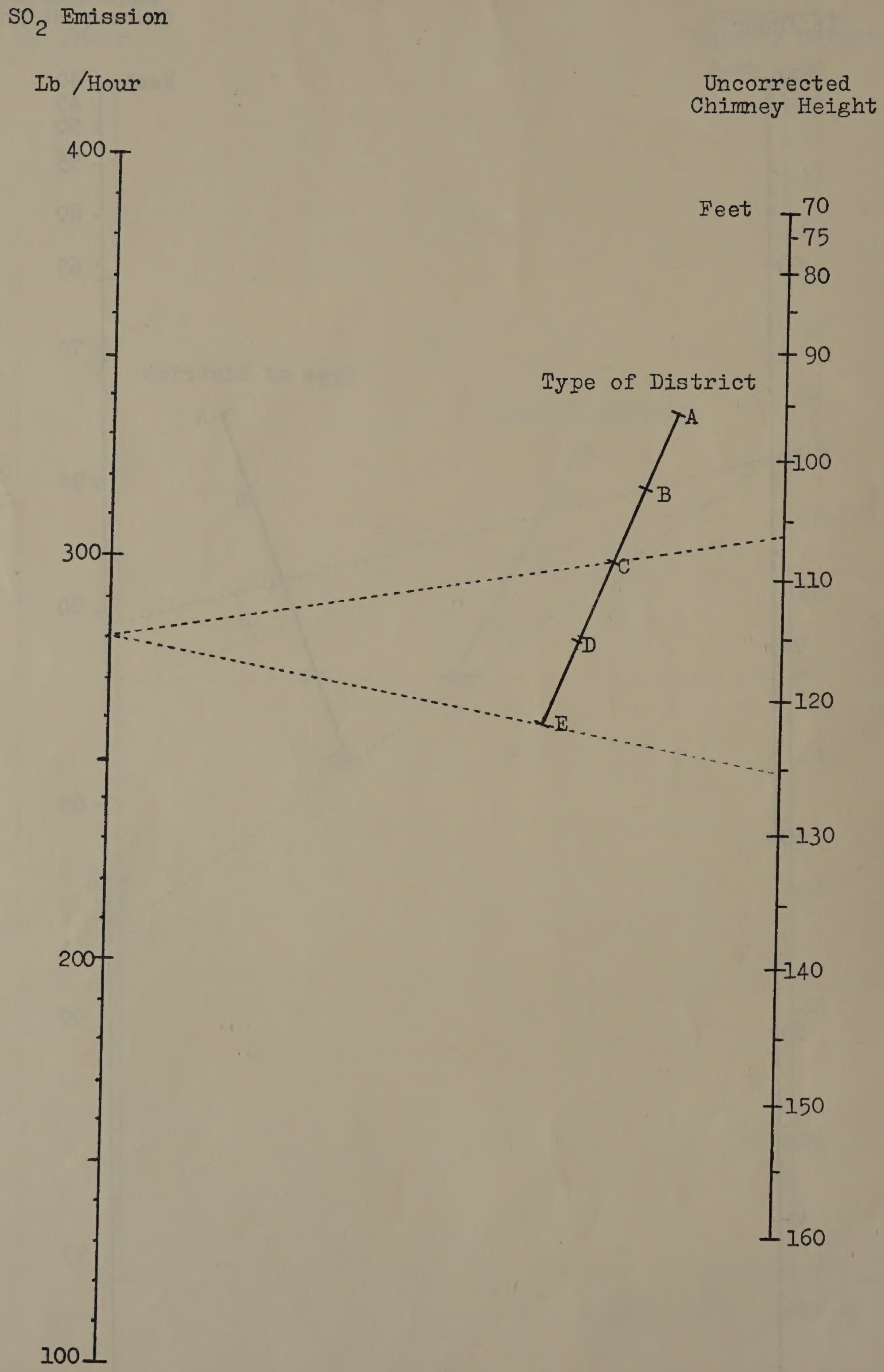
Small Installations



APPENDIX III

Uncorrected Chimney Heights

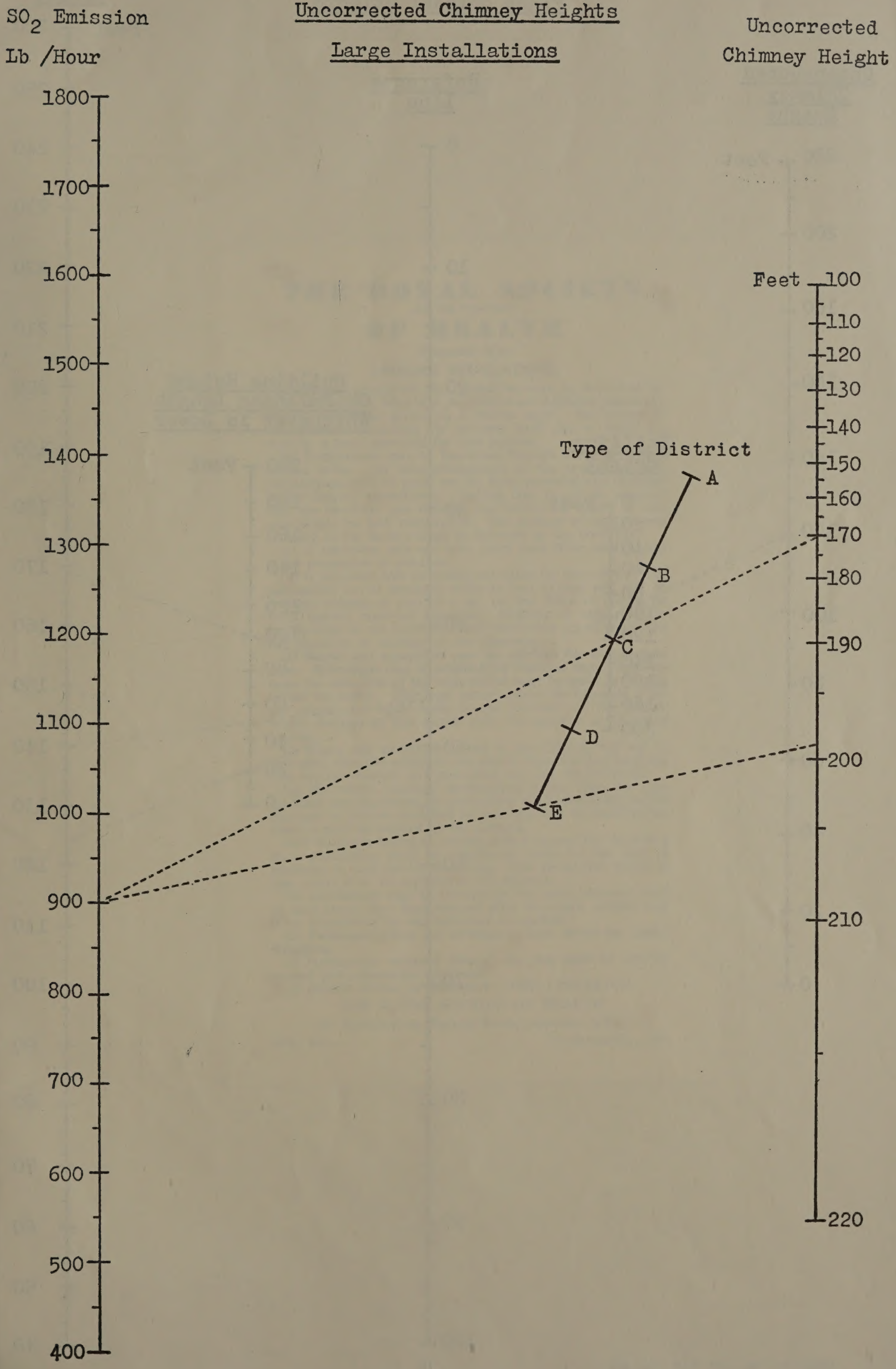
Medium Installations



APPENDIX IV

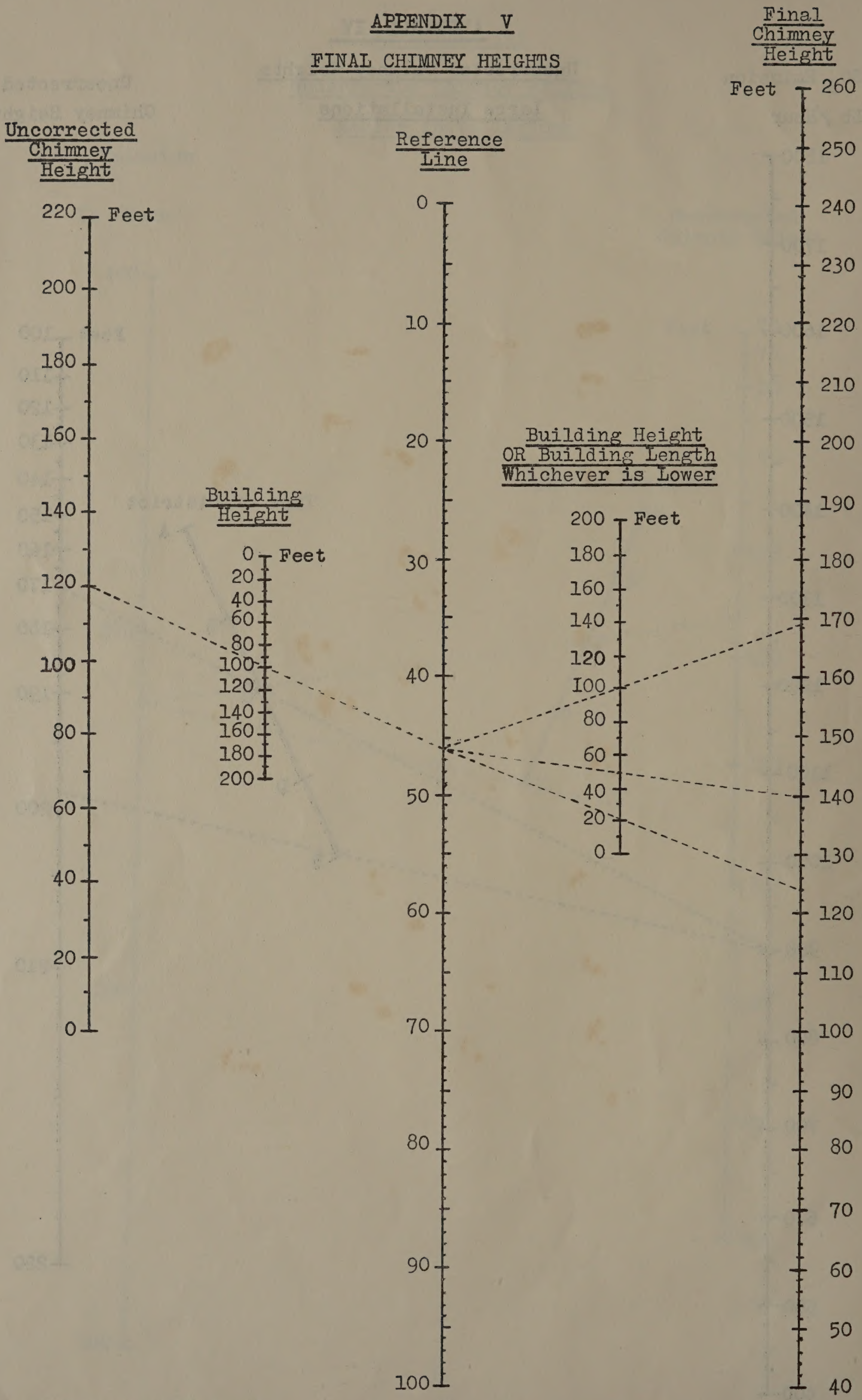
Uncorrected Chimney Heights

Large Installations



APPENDIX V

FINAL CHIMNEY HEIGHTS



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